DOCUMENT RESUME

ED 257 637 SE 045 573

AUTHOR Jones, Lyle V.
TITLE Black-White Differences in Mathematics: Some New Research Findings.
PUB DATE 85
NOTE 13p.; Paper presented at the Annual Meeting of the American Educational Research Association (69th, Chicago, IL, March 31-April 4, 1985).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Black Students; Educational Research; *Enrollment Trends; High Schools; *Mathematics Achievement; Prediction; *Racial Differences; *Secondary School Mathematics
IDENTIFIERS *Course Taking Patterns; *Mathematics Education Research

ABSTRACT

Is the effect of mathematics course-taking on test scores the same or different for black males, black females, white males, and white females? To answer this question, the regression results for 9700 members of the 1980 high school sophomore cohort from the High School and Beyond study were analyzed. It was concluded that: (1) for all students, a sizeable contribution to mathematics test scores beyond that predicted from earlier performance is associated with four or five high school credits in advanced mathematics, or with three credits, one of which is calculus; and (2) the relation between observed and predicted mathematics test scores is essentially the same for black males, black females, white males, and white females. Mean differences among these groups in senior-year mathematics test scores can be fully explained jointly by: (a) disproportionate representation at the several levels of mathematics course-taking; and (b) group differences that already were evident in the sophomore year. (MNS)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

For presentation, AERA meetings in Chicago, April 1, 1985.

Black-White Differences in Mathematics: Some New Research Findings

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Lyle V. Jones

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Lyle V. Jones

The University of North Carolina at Chapel Hill

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED257637

Many studies have confirmed that average mathematics achievement test scores for black school children are lower than for white school children of the same age or grade in school, even though that average difference has declined over the last 15 years (Burton and Jones; 1982, Jones, 1984). A study of 1980 high school sophomores and 1980 high school seniors based on data from High School and Beyond is no exception. On a test of computation, arithmetic reasoning, graph reading, and elementary algebra and geometry, average scores for black sophomores were found to be below those for white sophomores, and average scores for black seniors were below those for white seniors by nearly one test-score standard deviation.

It also is well established that mathematics test scores of high school students are closely related to the number of high school mathematics courses taken by those students. Strong evidence for this comes both from the National Assessment of Educational Progress (Welch, Anderson, and Harris, 1982; Jones, 1984; Jones, Burton, and Davenport, 1984) and from High School and Beyond. The analysis of data from High School and Beyond demonstrates that some effects of taking advanced mathematics courses survive an adjustment for the confounding variables: socioeconomic status, verbal test scores, and scores on the same mathematics test taken two years prior to the students' senior year of high school (Jones et al, 1985; Wisconsin Center for Education Research, 1984). I propose today to look in more

SE 045 573

BEST COPY AVAILABLE

detail at data from High School and Beyond, asking whether the overall findings concerning the influence of mathematics courses taken pertain equally to subgroups of students classified by ethnicity (black, white) and sex.

About 9700 members of the 1980 sophomore cohort from High School and Beyond have 1982 mathematics test scores as well as scores on the mathematics and verbal tests in 1980 and questionnaire data both for 1980 and 1982. Analysis of these data shows that about half of the total variance in 1982 mathematics test scores can be explained by differing numbers of transcript credits in mathematics courses at the level of Algebra I or above. In addition, a covariance adjustment of mathematics test scores for SES, 1980 verbal test score, and 1980 mathematics test score leaves some residual variance of 1982 test scores associated with credits in advanced mathematics (Jones, et al, 1985). Is the effect of mathematics course-taking on test scores the same or different for black males, black females, white males, and white females? To answer this question, the regression results for the 9700 high school sophomore cohorts from High School and Beyond will be applied separately for each ofthe four subgroups of students.

Exhibit 1 shows the values of $\bar{Y}$, the mean transcript-weighted (National Opinion Center, 1983) 1982 mathematics test score for black and white males and females categorized by six levels of mathematics course-taking, M = 0 to M = 5, depending on the number of transcript credits at the level of Algebra I or above. The mean test score for black students, 41% correct answers, is below that for white students, 60% correct, by about nine tenths of a standard deviation of test scores. The mean for all females, 56% correct, is about two tenths of a standard deviation lower than that for males, 60% correct.

The distribution of students by ethnic group and sex over levels of high school credits in advanced mathematics is shown in Exhibit 2. At M = 0, representing no credits for courses at Algebra I or above, appear about 32% of black high school seniors compared with about 16% of the whites. At M = 3 or greater appear 28% of the black students and about 45% of the white students. M has a value of 4 or 5 for more than 25% of white males, compared with 19% for white females, 13% for black males, and 11% for black females. This disproportionate representation over mathematics credits by ethnic group and sex may account, in part, for the differences of Exhibit 1 among average test scores of the groups.

At each level of M, we are able to find that linear combination of SES, verbal score, and earlier mathematics score that best predicts Y, the 1982 math score, ~~for members of each group of students~~. In Exhibit 3 is a plot of $\bar{Y}$, the observed mean test score, against $\bar{X}$, the predicted mean test score, for all students for levels of M from 0 to 5, ranging from the lower left to the upper right of the Exhibit. Note that 1982 mean test scores are predicted well from the linear combination of SES, 1980 verbal test score, and 1980 math test score. In this prediction, the influence of earlier mathematics score is great, that of verbal test score is more modest, and that of SES is small, almost negligible. (The ratio of standardized beta weights is 16 to 4 to 1.) Exhibit 3 suggests one line of relation between observed and predicted mean test score for M = 0, 1, and 2, and a higher line of relation with parellel slope for M = 4 and 5. The point for M = 3 falls between these two lines, about which I'll comment in a moment.

Add, now, to Exhibit 3 the results for subgroups of white males and white females [Exhibit 3A]. At each level of M, white males are seen to have higher observed and predicted mean scores than white females, but the suggestion of two distinct lines of relation remains.

Substitute, now, black male and black female subgroups for white male and female subgroups [Exhibit 3B]. Note that, for blacks at each level of M, males have higher observed and predicted mean scores than females.

Finally, superimpose the results for all four groups on those for the total group [Exhibit 3C]. The relation between mean observed and predicted mathematics test score is essentially the same, regardless of ethnicity and sex. The average observed score for each level of M is as close to the score predicted for one group as for any other. Here, again, we may note one line of relation for M of 2 or less and a higher line for M of 4 or more. There is evidence for a quantum jump in observed mean score of about 10 percentage points above the score predicted for students at M = 4 or more compared with students at M = 2 or less.

In an additional analysis at M = 3, students were separated into two groups depending on whether or not they had received credit for a calculus course. The mean test score for students at M = 3 with calculus is appreciably higher than that for students at M = 3 without calculus. For students at M = 3 with calculus, the points on the Exhibit fall on the upper line, along with students for whom M = 4 or 5, while for students at M = 3 without calculus the points fall on the lower line, along with students for whom M = 0, 1, or 2. This strongly suggests that a course in calculus plays a role similar to that of additional credits in mathematics. For students with M = 4,

M = 5, or M = 3 but including calculus, when compared with students who have fewer credits or whose credits do not include calculus, there is a substantial increase in observed scores beyond the level predicted, even though the test only requires knowledge of pre-calculus mathematics.

Several conclusions follow from these results.

First, for all students, a sizeable contribution to mathematics test scores beyond that predicted from earlier performance is associated with 4 or 5 high school credits in advanced mathematics, or with 3 credits one of which is calculus, to be contrasted with 1 or 2 credits or with 3 credits that fail to include calculus. This supports the hypothesis that the content of earlier mathematics instruction is better understood by students who have taken more advanced courses, especially calculus, than by equally able students, i.e., students with the same predicted scores, who have not taken more advanced courses in mathematics.

Second, the relation between observed and predicted mathematics test scores is essentially the same for black males, black females, white males and white females. Mean differences among these groups in senior-year mathematics test scores are able to be fully explained jointly by (a) disproportionate representation at the several levels of math course-taking, and (b) group differences that already were evident in the sophomore year. Policies that would reduce the average subgroup performance differences prior to high school together with policies to encourage black enrollment in advanced high school mathematics would be expected to reduce dramatically the subgroup mean differences in mathematics achievement for high school seniors.

REFERENCES

Burton, N. W. and Jones, L. V. (1982). Recent trends in achievement levels of black and white youth. Educational Researcher, 11 (4), 10-14.

Jones, L. V. (1984). White-black achievement differences: the narrowing gap. American Psychologist, 39, 1207-1213.

Jones, L. V., Burton, N. W. and Davenport, E. C., Jr. (1984). Monitoring the mathematics achievement of black students. Journal of Research in Mathematics Education, 15, 154-164.

Jones, L. V., Davenport, E. C. Jr., Bryson, A., Bekhuis, T., and Zwick, R. (1985). Mathematics and science test scores as related to courses taken in high school and other factors. UNC-CH, unpublished manuscript.

National Assessment of Educational Progress. (1983). The third national mathematics assessment: Results, trends, and issues. Denver, CO: Education Commission of the States.

National Opinion Research Center (1983). High School and Beyond transcripts survey (1982), data file user's manual. Washington, DC: National Center for Education Statistics.

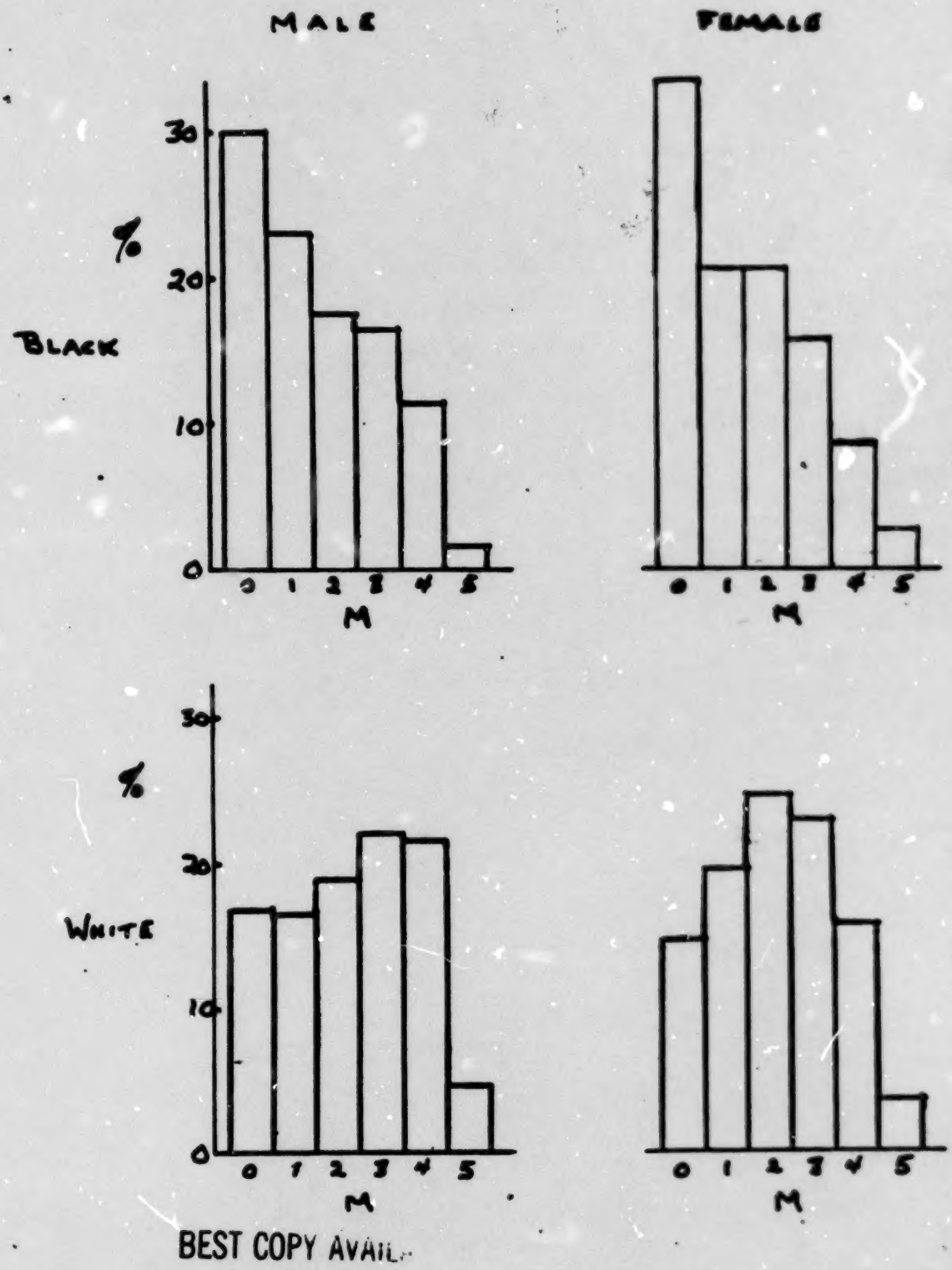
Welch, W. W., Anderson, R. E., and Harris, L. J. (1982). The effects of schooling on mathematics achievement. American Educational Research Journal, 19, 145-153.

Wisconsin Center for Education Statistics (1984). Effect of taking mathematics courses on mathematics achievement. Unpublished analysis of data from High School and Beyond.

Exhibit 1. Mean mathematics test score (% correct) by credits of advanced mathematics courses (M) for black and white males and females

M	Black males	Black females	White males	White females	Mean
0	32	28	39	38	37
1	36	35	51	47	47
2	45	41	60	56	56
3	55	50	70	66	67
4	69	59	79	76	77
5	83	60	84	81	82
Mean	44	39	62	58	58

Exhibit 2. Distribution over number of Math credits (M) by ethnicity and sex.



BEST COPY AVAIL.

EXHIBIT 3.

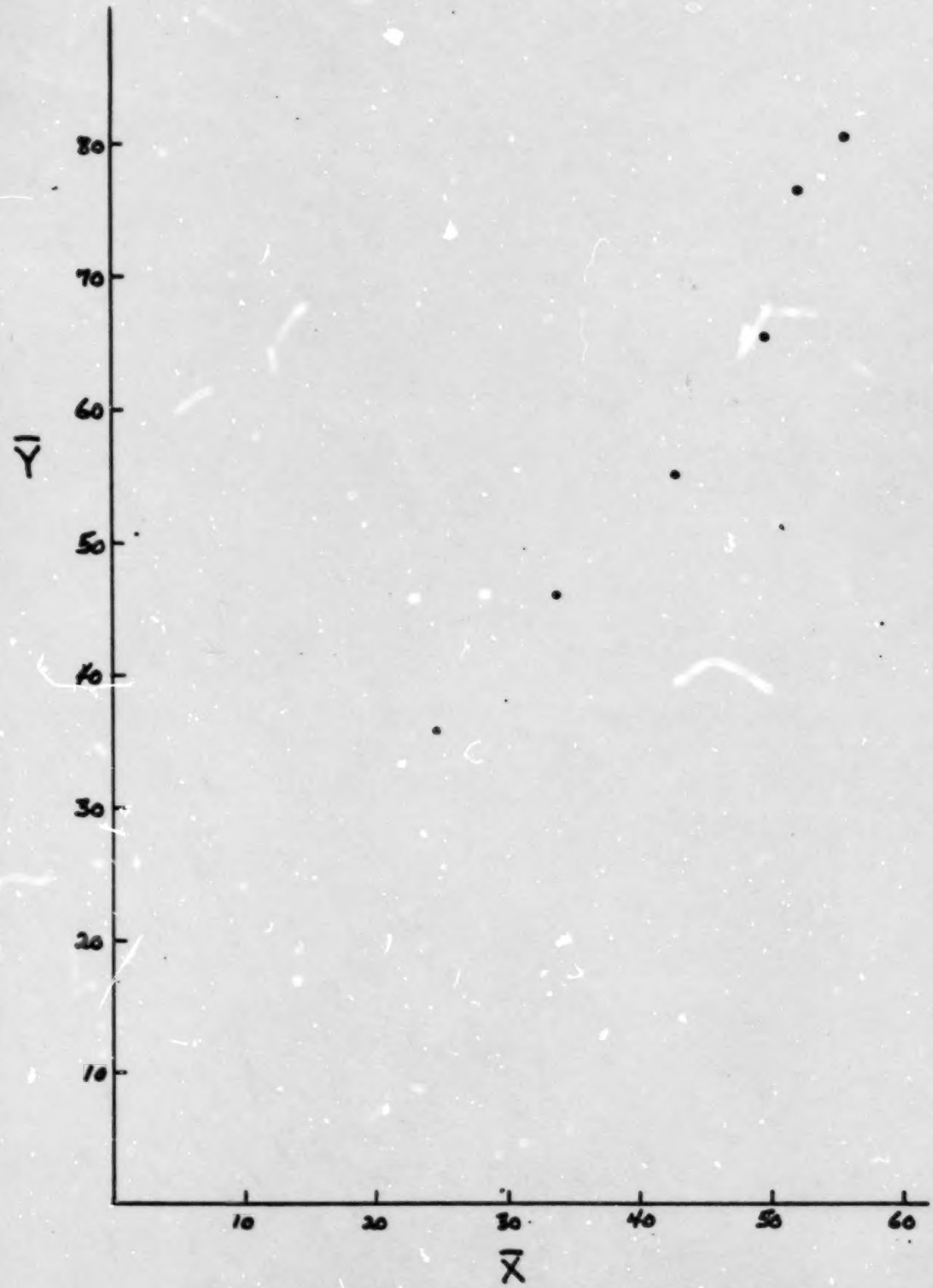
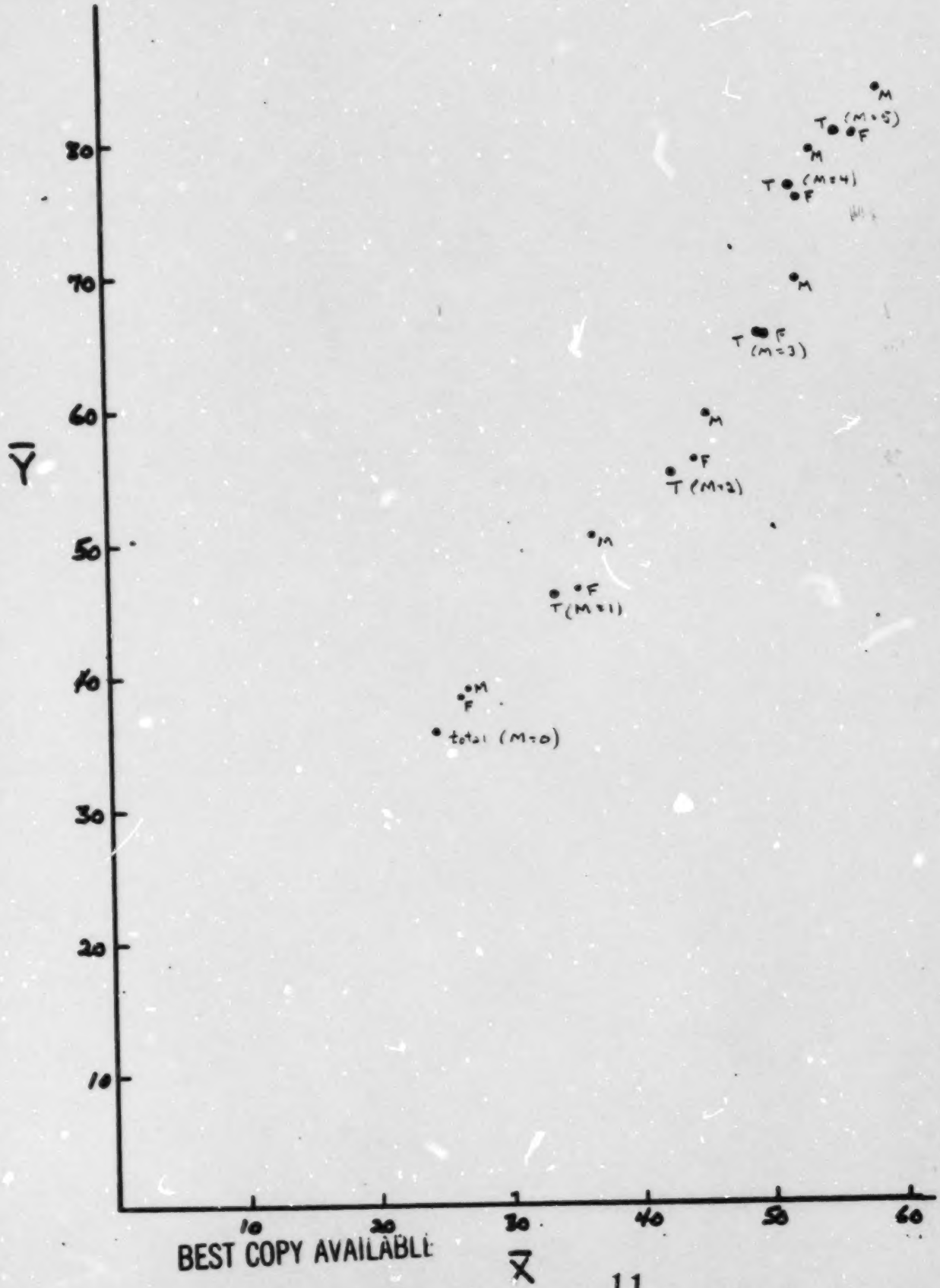
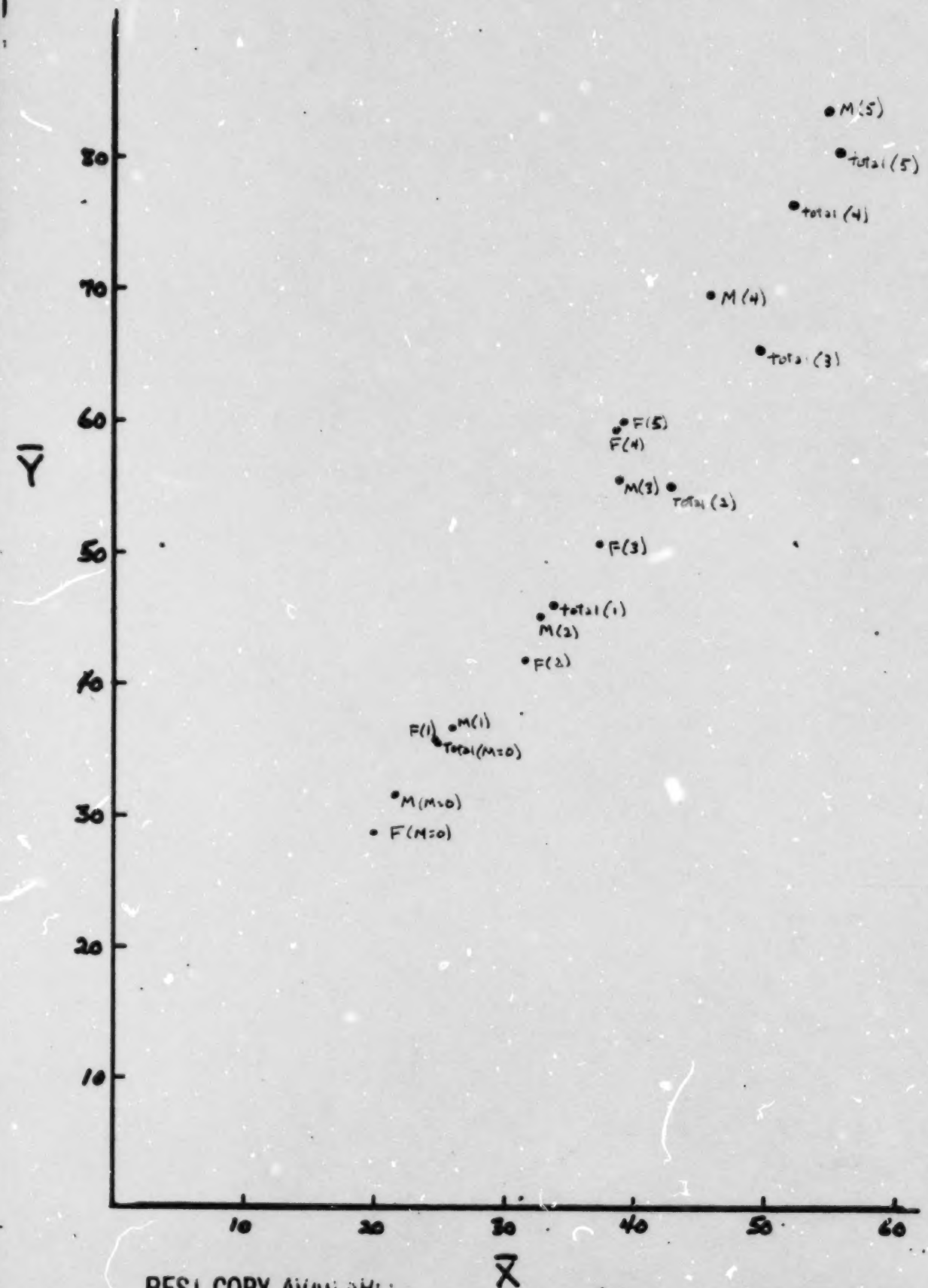


EXHIBIT 3A - FOR TOTAL AND WHITE MALE, WHITE FEMALE



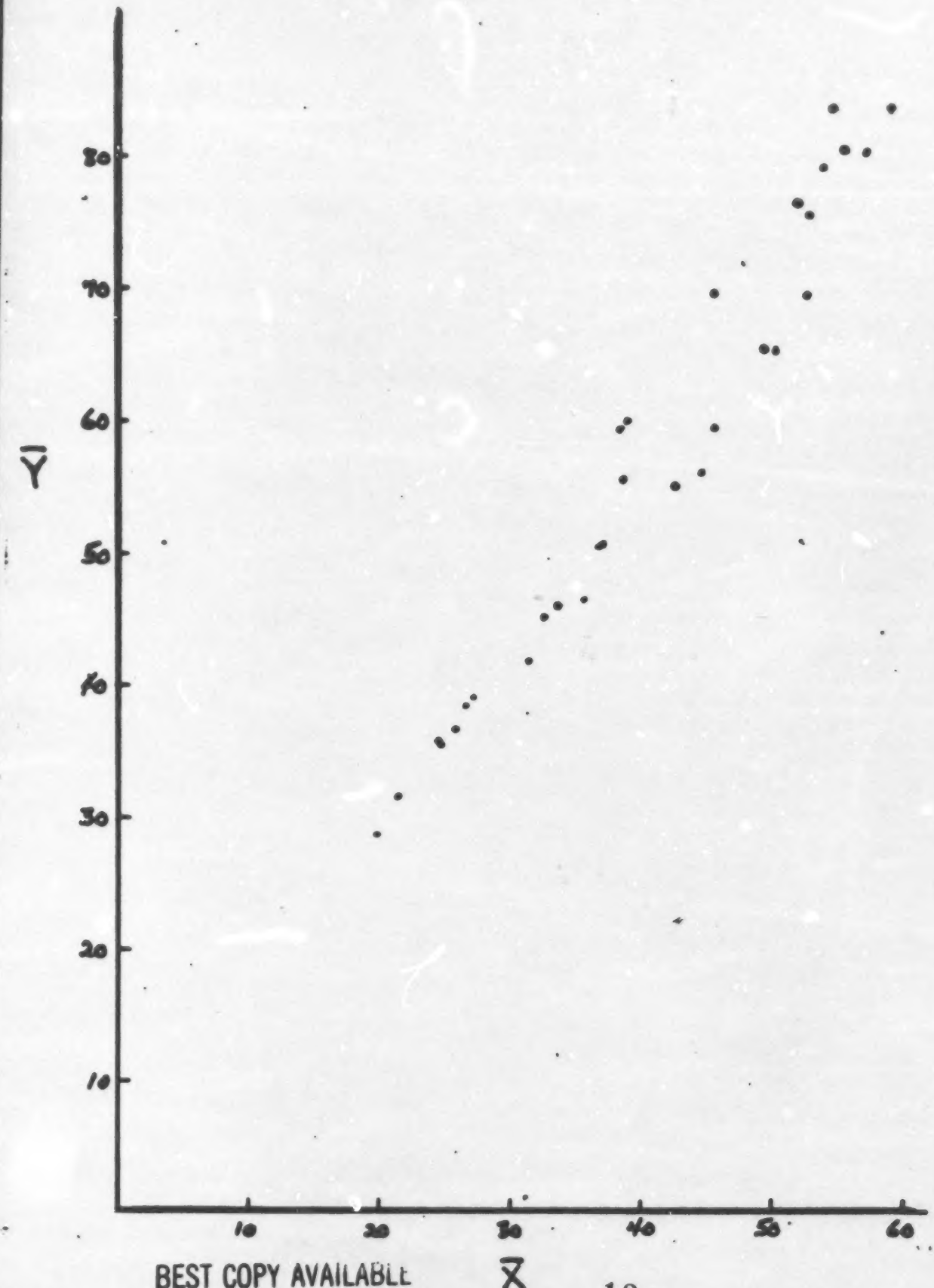
BEST COPY AVAILABLE

EXHIBIT 3B. FOR TOTAL AND BLACK MALE, BLACK FEMALE



BEST COPY AVAILABLE

Exhibit 3C. For Total, Black Male, Black Female, White Male and White Female.



BEST COPY AVAILABLE